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Which Credence Production Attributes Do Consumers Prefer? The Case of Milk

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WHICH CREDENCE PRODUCTION ATTRIBUTES DO CONSUMERS PREFER?

THE CASE OF MILK

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The interest of consumers for non-traditional food production attributes like no-antibiotics and animal welfare have made consumer preferences more complex. These new attributes, usually non-identifiable by inspection or experience of the product are called credence attributes. A side effect of the increasing number of attributes concerning consumers is the confusion regarding the practices included. An example is that of organic attribute that includes non-GMO, no-antibiotics and animal welfare production practices among others but is not considered as more important than the respective individual attributes. The objectives of this study are to analyze consumer preferences for milk production attributes by eliciting the relative importance of these attributes for consumers, and to identify possible sources of heterogeneity related to consumer characteristics. The research method used to elicit consumer preferences is Paired Comparison Method (PCM). Consumers from California and Texas were administered the online survey questionnaire in January 2017 by survey firm Information Resources Inc (IRI). In total, 1881 consumers completed the study. The production attributes examined are organic, antibiotic free, non-Genetically Modified Organisms (GMO), production without growth hormones, humanely raised, free-range and grass-fed. Random Parameters Logit (RPL) model was used for the estimation of participants'

preferences and the calculation of preference shares. Our results show that the most preferred production attributes are produced without growth hormones and animal welfare in both regions, with each attribute commanding a preference share greater than 20.0%. In general, there are differences in the ranking of the attributes between California and Texas, with the most significant being the 4.6% difference in the preference share of non-GMO attribute. Individual preference shares were estimated to examine demographic characteristics and buying habits of the participants as sources of heterogeneity in consumer preferences. Heterogeneity is found within the two regions with characteristics like gender, race and education influencing preferences. In addition to this, heterogeneity is region-specific as several consumer characteristics can be significant for a production attribute in one region but not in the other.

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CHAPTER 1. INTRODUCTION

Consumers' food preferences have become more complex to understand or evaluate as consumers are interested in production practices not related to traditional food attributes such as price or taste. For example, in the livestock sector, the production attribute of animal welfare for meat demand became a focus for consumers after media attention on animal raising practices (Tonsor and Olynk 2011). In addition to this, consumers became more interested in other production attributes such as produced without growth hormones, no-antibiotics and non-GMO (Ellison, Brooks and Mieno 2017). These newer attributes that are of concern to consumers are known as credence attributes. Credence attributes are defined as attributes that consumers cannot verify the presence of through search or experience of the product. Therefore, the connection of the credence attribute to the product mainly resides on the trust relationship between the firm and the consumer.

As consumers' interest in credence attributes has increased, companies have begun to use these attributes as part of their marketing schemes. New companies entered the food market or pre-existing companies achieved rigorous growth by taking advantage of the demand for products satisfying the needs of newly-shaped buying groups' needs. An example to understand the size of this demand is the rapid expansion of specialty stores like Whole Foods with 284 stores and $9 billion in sales in 2010 to 472 stores and $16 billion in sales in 2017, an increase of 39.2% and 44.8% accordingly (USSEC 2014 and 2017). Furthermore, an increase in labels has also brought about the creation of third party-verified food labels. One such label is the United States Department of Agriculture (USDA) organic label which has grown in popularity over time (Kiesel and Villas-Boas 2007). The total value of the organic market increased from $28.4 billion in 2012 to $35 billion in 2014 or an increase of 18.9% in two years with the organic dairy sector accounting for 15.0% of the total value of organic production in 2012 or $4.26 billion (USDA ERS 2017). In addition to this, organic milk production has grown as a percentage of total fluid milk sales in the United States. Organic milk percentage was equal to 3.3% of total fluid milk volume sales in 2010 (USDA AMS 2014) and increased to 5.8% in 2018 (USDA AMS 2019).

While total sales of organic milk have been on the rise, there also appears to be confusion in the underlying attributes of the organic label (Conner and Christy 2004). In general, a product can be labeled as organic if it is produced and processed by approved methods. More specifically, the organic label for milk requires that cows are managed by USDA organic standards for at least 12 months before milk can be labeled organic. The animals must be fed only USDA organic labeled grain or grass with the exception of trace minerals and vitamins for meeting nutritional requirements, they cannot be given any growth hormones, antibiotics, or other non-authorized medical substances or animal byproducts, and they must have access to pasture throughout the grazing season for at least 120 days, access to the outdoors throughout the year and access to shade, dry and clean bedding, shelter, space for exercise, fresh air, clean drinking water and direct sunlight (USDA AMS 2013 and 2016).

These requirements result in an organic label for livestock products that includes other production attributes that may appear on products as labels such as produced without growth hormones, no-antibiotics, non-GMO, animal welfare guidelines and depending on production region, grass-fed and free-range. In spite of this, possibly due to confusion regarding the organic label, there has been an observed decline in preferences for the organic label compared to single production attributes that are represented by the organic label (Ellison, Brooks and Mieno 2017, Bir et al. 2019).

The increasing complexity of consumer preferences and the lack of information for what the label means are two emerging topics for consumers. Considering that, the elicitation of consumer preferences for each production attribute independently could limit the significance of the results. A relative comparison of the production attributes may be more fitting for the mapping of consumer preferences. This way, a ranking of the production attributes for the general population would allow private institutions like cooperatives, processors and retailers to allocate their resources efficiently for further development of milk products that better reflect consumers' concerns.

The main objective of this study is to analyze consumer preferences for milk production attributes by eliciting their relative importance of these credence attributes. A second objective is to identify possible sources of heterogeneity related to consumer characteristics.

The remaining thesis is as follows. Chapter 2 contains a literature review regarding consumer preferences and is divided into the categories of willingness-to-pay (WTP) studies and multiple comparison studies. Chapter 3 presents methodology with a description of the Random Parameters Logit (RPL) model, the research method for the elicitation of consumer preferences, Paired Comparison Method (PCM), and the model specification. Chapter 4 presents the data with a summary of characteristics of the sample and the examining production attributes. Chapter 5 contains the results and discussion, followed by Chapter 6 where a short overall summary of the research and its limitations are presented as a conclusion.

CHAPTER 2. LITERATURE REVIEW

There is a significant amount of literature that aims to identify consumers' WTP for production attributes and claims such as Janssen and Hamm (2012), Adalja et al. (2015) and Lim and Hu (2016). These studies examine a single or a small group of production claims. Usually, the methods of hypothetical choice experiments or choice experiments with real products are selected to elicit consumer preferences about these attributes. Although there is agreement on the value of consumers' WTP for the production attributes examined among the studies, a contradicting result regarding consumers' WTP may also occur in the literature for the same production attribute. This contradiction is rational if one takes into consideration the different conditions each experiment is conducted under or the different products examined. More specifically, these studies offer a precise quantification of consumer preferences per attribute for a specific product independently, but they lack a comparison of the production attributes of the examined good. That specificity on attributes and products generates a research area for further exploration. As mentioned in the introduction, the ranking of production attributes in terms of importance for consumers is emerging and this article aims to contribute in this direction. This contribution is attempted with the examination of the consumers' relative importance for food attributes on milk. This section provides a brief overview of literature on WTP and food attribute ranking studies.

2.1 Willingness-to-Pay (WTP) Studies

As mentioned in the introduction of the chapter there are numerous WTP studies examining consumer preferences. The studies chosen to be included in this section are studies that examine credence attributes for beef and milk products as also studies that examine the organic attribute.

Motivated by a cow testing positive for Bovine Spongiform Encephalopathy (BSE) in Japan, McCluskey et al. (2005) examined WTP of Japanese consumers for BSE-tested beef. A similar study by Janssen and Hamm (2012) examines a single food attribute, organic, for different products. In their article, WTP of European consumers in six different countries was examined regarding different organic logos with real products from both animal and plant sectors. Other studies examine WTP for multiple food attributes on both products of animal and plant sector. Popular food attributes and claims for this kind of study are organic, feed practices and local claims. For example, Lim and Hu (2016) examined claims in regard to beef loin steak that included local, organic, feed practices and BSE on Canadian consumers. Bazzani et al. (2017) examined Italian consumers' preferences for local and organic claims on applesauce and their connection with personality traits. Adalja et al. (2015) examined consumer preferences by estimating WTP for grass-fed and local claims for ground beef in Maryland. Hu, Batte and Ernst (2012) examined WTP for different local claims, organic certifications, family farming, nutritional logos and brand for blackberry jam in Kentucky and Ohio.

There are a few studies related to food attributes and milk. Wolf, Tonsor and Olynk (2011) examined US consumers' WTP for the claims of Recombinant Bovine Somatotropin (RBST)-free, feeding practices, family farming, local, enhanced food safety and claim certification (private or USDA) for milk. Brooks and Lusk (2010) used both revealed preference data (actual purchases) and stated preferences of consumers to determine the WTP of consumers for organic and cloned milk as well as for RBST, a growth hormone. In a similar study, Brooks and Lusk (2012) examine the consistency of US consumers' private and public views towards cloned ground beef and milk but also the WTP for meat attributes, leanness and saturated fat content, and milk attributes, fat content levels and RBST-free.

2.2 Multiple Comparison Studies

One of the first studies to test the relative significance of production attributes among consumers was conducted by Lusk and Briggeman (2009) and the authors introduced Best-Worst Scaling (BWS) as a research method for ranking consumers preferences regarding food attributes. Lusk and Briggeman (2009) did not examine the products of a specific sector such as livestock products but generally examined attributes regarding food. Their results showed that food safety was the most important attribute followed by nutrition, taste and price. The existence of heterogeneity in consumer preferences is also a notable result. More specifically, the relationship between the examined attributes and organic purchasers was examined with significant observed differences between organic and non-organic purchasers on preference shares for the attributes of price, naturalness and environmental impact.

To examine the external validity of the findings on the previous study on how consumer preferences on production attributes impact actual consuming behavior, Lusk (2011) conducted a survey. The examined products were organic milk and organic eggs. Lusk used a combination of consumers stated preferences for food attributes and actual purchase data to obtain explanatory variables and relate them with purchase habits. The method used to acquire consumer preferences on food attributes was PCM. Results confirmed food safety as the most important food attribute followed by nutrition, taste and price. Heterogeneity in preferences among participants was significant with large differences in preference shares per individual.

Regarding the explanatory power of the food attributes, econometric analysis in both organic eggs and milk showed statistically significant positive relationship between the attributes of environmental impact, naturalness and tradition. The food attribute of tradition was described by Lusk (2011) as the perseverance of traditional consumption patterns. Food values with statistically significant negative impacts were food safety, convenience, appearance, fairness and price. Demographic variables of age, race and place of residence also showed significant impact on organic demand for both products but specifically, in the case of organic milk the presence of children in the household was also an important factor, indicating another source of heterogeneity in consumer preferences. It is significant to note that although organic demand for both products presented similar results in terms of explanatory parameters there was low correlation between them both in total volume of purchases and in organic share of total purchases.

Lister et al. (2017) used the survey of Lusk and Briggeman (2009) as a stimulus to conduct a similar study examining the relative importance of food attributes using a latent class model. The four products selected were ground beef, beef steak, chicken breast and milk and the research method was BWS. The examined attributes were similar to these of Lusk and Briggeman (2009) with small modifications to better fit livestock products. Again, food safety was ranked the most important attribute in all products followed by freshness. In the less important attributes, the ranking among them was altered for each product. An analysis using a Latent Class Model (LCM) that divided the sample into different classes was conducted to identify a possible relationship between heterogeneity and the sociodemographic background of the participants, but the hypothesis was rejected.

Ellison, Brooks and Mieno (2017) examined the relative importance of different production claims for beef, milk, chicken and eggs. The most important production claims across all groups were the ones related to the claim of no administration of growth hormones and the non-use of GMO in production but also animal welfare. As in the previous study, the ranking of less important claims differed based on the product. Heterogeneity in preferences was found and was related to sociodemographic factors such as gender, age, income, education or place of residence. Cummins et al. (2016) examined the relative importance of different pork products and production attributes in the United States. The research method was BWS and the results showed food/pork safety as the most important attribute followed by taste, animal welfare and price. Statistically significant correlation between the examined attributes was found but the only two attributes that could be considered as highly correlated were locally raised/farmed pigs and locally processed pork with correlation level equal to 0.798. An interesting addition of Cummins et al. (2016) was the inclusion of a validity test, asking participants to select a specific number in a question, in the econometric analysis. The results showed that passing the validity test could impact the preference shares of food attributes. Heterogeneity in consumer preferences was also present with gender, age, income, having a source of animal welfare information, pet ownership, pork purchasing frequency and diet being impactful across all attributes.

Bir et al. (2019) conducted a study regarding consumers' preferences towards milk at the national level. The examined attributes were nine in total and included search attributes, container material, price, container size and brand, and credence attributes, RBST-free, fat content, animal humanely handled, organic diet of animal and required pasture of animal. The research method of BWS was used with three econometric models, Multinomial Logit Model (MNL) which was the base model, RPL model to account for heterogeneity and LCM to group participants based on their preferences and acquire a better picture of heterogeneity in consumer preferences. The milk attributes with the highest preference shares were price, fat content and animal humanely handled. Five different groups of consumers were created. Interestingly, these consumer segments had no significant difference in terms of sociodemographic variables except for education but presented significant differences in shopping behavior. More specifically, in the buying habits of milk amount purchased during a week, fat content of purchased milk, frequency of paying attention to information coming from labels on the products of meat, egg or milk and if they do pay attention, what labels do they seek for.

Gracia and Magistris (2016) used the method of direct ranking (DR) to elicit European consumer preferences regarding label in the European market. They examined popular labels regulated by the European Union (EU) including the EU organic logo, the Protected Designation of Origin (PDO) and nutritional fact panel, and others not regulated by EU like local origin, locally produced good and directly sold by the farmer, the food miles indication, carbon footprint information, and a higher level animal welfare indication. Researchers found that consumers prefer the EU regulated logos over the others. Heterogeneity in preferences was identified and linked with sociodemographic characteristics and buying criteria of the consumers who were divided into different groups, categorized by which label participants preferred most.

Lagerkvist (2013) in Sweden examined 30 different food labels for beef using DR and two variations of BWS in order to compare the methods and their results. The two variations were the usual BWS method and Anchored Best-Worst Scaling (ABWS). The highest ranked attributes for both methods were expiration date, country where the animal was fattened/bred, price, information about if the animal received preventative medication or not, extent of good animal welfare for the livestock production, country where the animal was born, weight and country where the animal was slaughtered. Econometric analysis showed that all methods were equally understandable by the participants, the ranking of attributes between the methods were generally the same, there was difference between the BWS variations in terms of weighting importance distribution of examined attributes and level of heterogeneity, dependence of attribute discrimination on the research method, non-consistency in attribute ranking when using aggregation of individual ranks or attribute weights to get results and when using choice probabilities across methods and at last, different methods presented different deviations on attribute ranking.

Another type of studies is concentrated in consumers' values and beliefs underlying their preferences. Sax and Doran (2016) examined the relationship between health, safety and environment with organic, low or no fat, natural GMO and non-GMO labels on three different products (cereals, sugar and apples) by asking participants to rank the labels in these three areas. The study was conducted in California. Results implied independence between consumers' views on safety, environment and health and the examined products. On the other hand, organic label was ranked the highest while non-GMO label was ranked the lowest in all areas across all products. Last but not least, the average scores for environment, safety and health all have similar values among products implying, according to Sax and Doran (2016), that these human values are confounded by the participants.

Moreover, Honkanen, Verplanken and Olsen (2006) examined ethics, attitude and intention of consumers for consumption of organic products in Norway. Participants rated in terms of importance various ecological, political and religious motives but also their attitude toward organic food and their intention to consume it in the near future. Econometric analysis indicated that ecological motives rated as the most important, followed by attitude to consume and political motives. All examined criteria showed positive relationship with attitude toward organic products. Ecological motives, constituted by animal welfare and environmental impact, showed the strongest impact, political motives such as politically acceptable country of origin came second, and religious motives came last regarding attitude affection. Also, a strong impact between attitude towards organic food and intention to consume was confirmed.

CHAPTER 3. METHODOLOGY

The econometric analysis of the data is done in two parts, each one corresponding to one of our research objectives. In order to answer our research question about which credence attributes consumers prefer for milk, an RPL model was used, with the elicitation method of the preferences being PCM. Because RPL is based on another model, an explanation of the base-model follows to obtain a more complete picture of the RPL model. Then to test for possible sources of heterogeneity related to consumer characteristics, individual preference shares and the Ordinary Least Squares (OLS) method were used. Chapter 3 consists of Section 3.1 where the RPL model is presented, Section 3.2 presents PCM and the method specification to examine the main objective, and Section 3.3 briefly explains individual preference shares were estimated and why OLS was used, and the model specification to test for heterogeneity sources.

3.1 Random Parameters Logit Model

The RPL model used in the econometric analysis is based on the MNL while MNL is based on the logistic model (Train 2003). The logistic model or logit model is used to estimate the effect of one or more independent variables on the binary dependent variable (Train 2003). In cases of variables that have more than two available choices, nominal variable or categorical variable, MNL is used (McFadden and Train 2000). Both models result in the probability estimation of an alternative being chosen based on Random Utility theory. More specifically, in MNL model every choice has a utility function which includes the variables observed by the researcher and an error term of non-observed variables that impact the utility obtained by that choice. This utility function has the form:

$$U_n(i) = V_n(i) + \varepsilon_n(i) \tag{1}$$

with $U_n(i)$ being the utility function of individual *n* out of total *N*, $V_n(i)$ is the systematic part of the utility function which contains the observed variables and $\varepsilon_n(i)$ is the error term.

The error term plays a key role in order to shape the MNL model. The reason behind this is that the error term of the utility functions for all individuals are used to make three assumptions which compose the MNL model (Koppelman and Bhat 2006). The first assumption is that the error terms are Gumbel distributed. Gumbel distribution or Generalized Extreme Value Distribution Type-I, is modelling the distribution of the maximum of a finite number of samples for various distributions. Gumbel distribution is often used in extreme value analysis to predict the occurrence probability of unusual (extreme) events. Secondly, the distribution of error terms is identical and independent across alternatives and thirdly, the distribution is also identical and independent across individuals. Based on these assumptions the choice probability of an alternative for the MNL model is created:

$$P_n(i) = {exp[V_n(i)]}\Big/{\sum_{j=1}^{J} exp[V_n(j)]} \tag{2}$$

where P_n is the probability of individual *n* choosing alternative *i*, $exp[V_n(i)]$ is the general expression that uses the systematic part of the utility function of chosen alternative *i* for the probability and $exp[V_n(j)]$ is the general expression that uses the systematic part of the utility function of alternative *j*. This expression for the MNL or logit model takes an exponential form with Euler's number (e) being the base and $V_n(i)$ being the exponent (Wittink 2011).

The use of maximum likelihood estimators is common to estimate the parameters of the independent variables for econometric analysis, in both models. A brief explanation of the theoretical framework for maximum likelihood estimators is described in this paragraph. The mechanism behind the estimation of the maximum likelihood estimators in MNL model needs a binary variable (y_{in}) which takes the value of one if individual n out of total N, chooses alternative i and zero if chooses alternative j (logit model). For logit model, two vectors are made containing all the possible values, K, of the two alternatives, Assume vector x_{in} for alternative i and vector x_{jn} for alternative j. Using the logarithm of the likelihood function created for convenience reasons, the following formula is created:

$$logL(\beta_1, \beta_2, \ldots, \beta_k) = \sum_{n=1}^{N} y_{in} logP_n(i) + y_{jn} logP_n(j) \tag{3}$$

where L is the likelihood function and $\beta_1, \beta_2, \ldots, \beta_k$ are the parameters. The estimates of these parameters are the solution to the maximization of the likelihood function. Partial derivatives in respect to β's are calculated and are set to zero, following the first order condition procedure. If first order conditions result in multiple solutions, then second order conditions are needed, and maximum is found with help of the vectors containing the values of each alternative to obtain a reliable estimate (Wittink 2011). The procedure for MNL model is similar to that of the logit model but with more alternatives added.

These three assumptions that are requirements for Eq. (2) lead to the property of Independence from Irrelative Alternatives (IIA) which states that for every individual, the choice probability of two alternatives is completely independent and thus unaffected by the existence or the characteristics of other alternatives (Koppelman and Bhat 2006). Train (2003) explains the IIA as the logit probability ratio of i and j that is independent from all other alternatives except i and j or all other irrelevant alternatives. The parameters $\beta_1, \beta_2, \ldots, \beta_k$ which are now $V_n(i)$ and $V_n(j)$, are estimated using maximum likelihood estimation. As a result, the variable in the econometric model is binary with value one for the combination of attributes chosen by the participant, and zero for all other combinations.

The disadvantage of MNL model is also the IIA assumption, mentioned above, as it excludes preference heterogeneity among participants by not allowing random variance for the parameters of observed variables among individuals. In other words, all individuals show the same importance level for an alternative. As Train (2003) explains there could be an unobserved part of the error term that can be correlated with the other alternatives and impact utility of the individual, the "stochastic" part of the utility in Eq. (1) which can be correlated with the previously irrelevant alternatives. The solution of this problem resides on the RPL model which expands the MNL model. As its own name reveals, RPL enables the random variance of the parameters or coefficients of the dependent variables in the econometric analysis, and the time correlation of unobserved factors (Zeng 2011). Regarding the formula transformation of Eq. (2), for convenience, $V_n(i)$ and $V_n(j)$ are replaced with $\tilde{\kappa}_{ni}$ and $\tilde{\kappa}_{nj}$ respectively. In MNL model, the systematic part of Eq. (1), $\tilde{\kappa}_{ni}$ does not contain the preference of individual n, as all individuals show the same importance for an alternative. That changes with RPL model as the specific term becomes:

$$\tilde{\kappa}_{ni} = \bar{\kappa}_i + \sigma_i \theta_{ni} \tag{4}$$

with $\bar{\kappa}_i$ being the mean of κ_i in the population, σ_i being the standard deviation of $\bar{\kappa}_i$ in the population and θ_{ni} being a random term with a normal distribution having its mean equals to zero and its standard deviation equals to one. Replacing Eq. (4) into the Eq. (2), now the choice probability depends on the random term θ_{ni} and is different for each individual.

According to Lusk and Briggeman (2009) an RPL model can be defined as an error-component model in which every alternative has its own variance and because of that creating differences in scale of importance, elements of scale represented by $V_n(i)$, over alternative options. This interpretation, due to standard deviation being normalized to one for error terms in RPL, may lead mean estimates of $\tilde{\kappa}_{ni}$ being not easily interpretable with scale differences. Although the need of mean estimates in RPL being reliable was satisfied by McFadden and Train (2000) and Train (2003) who showed that RPL can approximate any random utility model, a better way to interpret the estimations (coefficients) is needed. The solution was introduced by Lusk and Briggeman (2009) with the implementation of preference shares which are the forecasted probability of each alternative being chosen as the most important to the individual n. Assume that the estimate of the analysis for one alternative is β_i with i being the alternative out of J. Then the share of preference for i^{th} alternative (PS_i) is:

$$PS_i = {}^{exp(\beta_i)}\Big/_{\sum_{j=1}^{J} exp(\beta_j)} \tag{5}$$

or the ratio of the Euler number in the power of the estimate β_i, divided by the sum of Euler number in the power of the estimate of all alternatives *J*. The sum of all preference shares of the alternatives is equal to one.

Because in RPL the choice probability is based on a random term which is unobserved, it cannot be calculated as before. To obtain an accurate estimate of the choice probability, different methods to obtain a reliable estimate of the random term can be used. Some of the most popular ones are the classic Monte Carlo method using pseudo-random numbers or the quasi-Monte Carlo method using quasi-random numbers. The quasi-Monte Carlo method produces equally or more accurate estimates from the classic Monte Carlo method with less computational requirements (Zeng 2011). A usual generation method of the quasi-random numbers are the Halton sequences (Train 2003 and Zeng 2011).

3.2 Paired Comparison Method and Model Specification

As mentioned before the research method used for eliciting participants' preferences is PCM as used in Lusk (2011). David (1988) introduced PCM as a research method to identify preferences. A more complete analysis of the method was done by Marley and Louviere (2005) with examination of different probability models and development of theoretical results and potential relationships between varying types of choices. More specifically in the PCM, participants are asked to select one out of two objects belonging to a choice set of *J* different objects. This choice maximizes their derived utility difference or as the question is expressed, the most important attribute to them. The presence of *J* in the choice set provides *(J×J-J)/2* available combinations for participants.

Adjustment of the choice probability of an alternative for RPL model is needed as in PCM the individual chooses between two alternatives per question. Adjusting Eq. (2) for PCM is done following Lusk (2011). Consider *λ* as the alternative chosen as more important than alternative *ν* by individual *n,* then the probability of individual *n* choosing *λ* over *ν* as mentioned above, is the probability that $U_n(\lambda) > U_n(\nu)$ or $\tilde{\kappa}_{n\lambda} + \varepsilon_n(\lambda) > \tilde{\kappa}_{n\nu} + \varepsilon_n(\nu)$ or $\tilde{\kappa}_{n\lambda} - \tilde{\kappa}_{n\nu} > \varepsilon_n(\nu) - \varepsilon_n(\lambda)$. Under the assumption that the differences in the error terms are under logistical distribution then Eq. (2) becomes:

$$P(\lambda\ chosen\ as\ more\ importnat\ than\ \nu) = \exp(c + \tilde{\kappa}_{n\lambda} - \tilde{\kappa}_{n\nu}) \Big/ 1 + \exp(c + \tilde{\kappa}_{n\lambda} - \tilde{\kappa}_{n\nu}) \qquad (6)$$

with *c* being a constant considering the order effect. Because of this adjustment the value of Eq. (6) and as a consequence the value of maximum likelihood in Eq. (3) are based on the importance given to the alternative by each individual or in other words by θ_{ni}.

The current study uses seven milk production attributes, meaning *(7×7-7)/2=21* possible combinations. Each survey participant was randomly assigned five questions. Therefore, each participant answered five questions on which milk production attribute was most important to them. The examining milk production attributes are “milk is certified organic”, “cows are not administered antibiotics”, “cows are not administered growth hormones”, “cows are humanely raised”, “cows are grass-fed”, “genetically modified organisms were not used in the production of milk”, and “cows are raised in a free-range environment”. All the attributes and a short description are included in Table

1. An example of a randomly assigned question is: "Which of the following two production methods and/or practices, is more important to you when purchasing milk or other dairy products? Cows are not administered antibiotics or cows are not administered growth hormones."

Based on the RPL model described above, Eq. (3) can be updated as followed:

$$LL_{ij} = \beta_0 + \beta_1\, org_{ij} + \beta_2\, no\_ant_{ij} + \beta_3\, no\_grho_{ij} + \beta_4\, hum\_ra_{ij} + \beta_5\, gr\_fed_{ij} + \beta_6\, no\_gmo_{ij} + \varepsilon_{ij} \quad (7)$$

where LL_{ij} is the dependent variable, the log of maximum difference likelihood in utility of participant *i* on the choice made for the combination of the question j; β_x is the coefficient of milk production attribute *x*; org_{ij}, no_ant_{ij}, no_grho_{ij}, hum_ra_{ij}, gr_fed_{ij} and no_gmo_{ij} are the milk production attribute choices as described in Table 1 of participant *i* in question j; and ε_{ij} is the error term of participant *i* in question j. The base of the model is the free-range production attribute and all coefficients are relative to that.

The survey was conducted in California and Texas, therefore three RPL models were analyzed; one for each region and then a model including both samples. The first model included the total sample, the second the California residents and the third the Texas residents. Based on the RPL analysis, preference shares were calculated using Eq. (5). The dependent variable of the models was the maximum difference on the log likelihood in utility of the participant. The independent variables were the milk production attributes included in the PCM questions.

3.3 Ordinary Least Squares Method and Model Specification

The second objective of the thesis is to identify possible sources of heterogeneity related to consumer characteristics. Testing the above, econometric analysis of the individual preference shares of the participants is required. In order to do that, individual parameters were estimated for each participant, transformed into individual preference shares using Eq. (5), and then used as response variables in a linear regression model following Lusk (2011) and Ellison, Brooks and Mieno (2017). OLS was used to estimate the impact of the participant's characteristics on the individual preference shares. The estimation of individual parameters was based on each participant's choices and was done using Halton sequences.

The dependent variable in econometric model is the individual preference share of each milk production attribute and the independent variables are the participant's demographic characteristics and their buying habits. In total, 21 regressions are conducted, seven regressions for each of the three different samples. A list of the participant's characteristics included in the model and their descriptions are in Table 2. The econometric model for the identification of possible heterogeneity sources is the following:

$$pref.share_i = \sum_{k=1}^{K} \beta_\kappa \, part.characteristic_{ik} + \varepsilon_i \tag{8}$$

where $pref.share_i$ is the value of the preference share of individual i; β_k is the coefficient of participant's characteristic k; $part.characteristic_{ik}$ is the characteristic k of individual i and ε_i is the error term of individual i.

The base of the model is a male participant, over the age of 65, not white, who has completed an advanced degree in education, annual household income of $100,000 or more, a household of three or more members, without a farm background, is not the primary shopper of the household, resides in California, purchases milk at least once a week or more, does not purchase milk at a grocery store, purchases food to be prepared and eaten by the family less than twice a month, has weekly expenses for groceries of $140 or more, does not purchase the store brand of milk, purchases skim milk in less than a half-gallon container, is skeptical of products labeled organic and the organic percentage of the annual consumed milk volume is zero. All the coefficient estimates are compared to this base.

CHAPTER 4. DATA

Online surveys were administered to households in the IRI National Consumer Network Panel. In January 2017, surveys were sent to 4,000 households in the IRI panel in California and Texas. A total of 1,988 people returned the surveys, implying a response rate of 49.7%. Due to incomplete responses, not all participants were included in the data and econometric analysis. More specifically, for the pooled sample 1881 surveys were included, 1013 were included for California and 868 for Texas.

The survey included a section on the elicitation of consumer preferences questions using PCM and a section regarding consumer's background. The consumer background section included questions on participant's gender, age, education, household income, household size, farm background and region of residence. The buying habits asked are the frequency of purchasing milk, the place of purchasing food, the frequency of purchasing food to be prepared and eaten at home, the weekly expenses on food, the brand of purchasing milk, the milk fat content, the size of milk container and the opinion towards organic products. Participants were also asked about additional production attributes when they purchase milk. IRI provided weekly milk purchase data of the participants from January 7, 2013 to January 6, 2016, in which the organic percentage of annual milk consumption was calculated for each of the respondents.

Table 3 reports summary statistics for the demographic variables. Regarding gender, 68.3% of the respondents are female. The average age of participants was 62 years old, with 43.9% of the sample being over 64 years old, 33.2% between 55-64 years old and 22.9% under 55 years old. The majority of the sample, 77.7%, reported belonging to the white/Caucasian race. Of the total participants that completed the survey, 38.8%

had some college education or trade/vocational school, 32.3% are college graduates and 16.9% have an advanced degree. In terms of income, 11.5% of the participants reported an annual income under$25,000, 24.0% of the participants reported an annual income between $25,000-$49,999, 17.9% reported an annual income between $50,000- $69,999, 23.7% reported between $70,000-$99,000 and 22.9% reported an annual income greater than $100,000. Over 48.0% of the households reported being two-person households, with 27.4% and 23.7% reporting being one-person and three or more person households, respectively. Moreover, 89.8% of the sample has no farm background and 93.5% of the respondents are primary shopper for their household. Regarding place of residence, participants are almost evenly distributed between California, 53.9%, and Texas, 46.1%. Comparing the pooled sample of California and Texas to the US Census in Table 3, there are more female participants, slightly older, with higher education and represent more the middle and high income classes. The race of the participant is similar to the US average. Examining each regional sample separately to the census of the respective region the same pattern is observed with the addition of overrepresentation of white race, especially in the California sample.

Table 4 reports characteristics regarding the buying habits of the survey participants. Approximately half of the pooled sample, 52.1%, buys milk at least once a week. The majority of participants, 93.8%, purchasing their food for home consumption at the grocery store or supermarket. It is significant to mention the category “other” for place of purchasing food includes targeted/specialty retailers, general/dollar stores, convenience stores, farmer markets and others. Moreover, 65.1% of the respondents reported that they purchase food to be prepared and eaten at home at least once a week. In addition to this, 52.0% of the participants indicate that their weekly expenses on groceries for their household is less than $80 while 38.3% of the sample reported that their weekly expenses are between $80 and $139. Around one tenth of the pooled sample, 9.7%, spends $140 or more for groceries each week. Store brand milk was preferred by 70.1% of the participants. The milk fat content preferred most in the sample is 2.0% followed by whole, skim and then 1.0% fat milk. The most preferred size of milk container was gallon size with 47.3% of the respondents choosing this option. Participants were asked if they agree with the statement “I am skeptical towards products labeled as organic” to elicit their opinion towards organic products. Half of the sample, 50.1%, agrees with the skepticism towards products labeled as organic (negative opinion), 29.0% of the respondents are neutral towards organic products (neutral opinion) and 20.9% do not agree with the statement (positive opinion).

Comparing the buying habits of the participants between the two sampling regions in Table 4, most of them were similar. Some differences worth mentioning were observed in the milk brand with a higher percentage of Texas participants (77.7%) buying the store brand compared to only 63.6% of California participants purchasing the store brand. Another difference between the samples was the rank between 1.0% fat and skim milk in the two regions. In California, responses showed 1.0% fat milk as third and skim milk as fourth while in Texas the order was reversed with skim milk being third and 1.0% being last. Finally, a higher percentage of participants in Texas (54.2%) indicated buying the gallon size milk container while 41.5% of participants in California purchased gallon.

Regarding the organic percentage of annual milk consumption, the estimation of the variable was based on the volume sales of participants’ actual purchases. The average percentage of organic purchased milk for California residents is 6.6% and 5.8% in Texas (Table 4). The shape of the distribution is identical for California and Texas regions, and because of that, only the distribution of the observations for the pooled sample is presented in Figure 1. The distribution is right-skewed implying that most of the participants do not purchase a large quantity of organic milk. More specifically, 1476 out of 1881 respondents or 78.5% of the sample has zero organic milk consumption.

As mentioned before, participants were also asked about additional production attributes they look at when purchasing milk. The available attributes and the participants' responses can be seen in Table 5. The majority of the pooled sample, 66.1%, reported that they purchase milk with no additional attributes or in other words, conventional milk. It is significant to clarify that the conventional milk option and all the other additional milk production attributes were mutually exclusive, and participants were allowed to select more than one milk attribute.

Regarding the additional production attributes the highest percentage is observed for produced without growth hormones with 15.4% of participants selecting it, followed by no-antibiotics at 13.7% and the organic attribute at 11.0%. On the other hand, the milk production attributes with the lowest values were animals being humanely raised with only 4.8% of respondents choosing it and free-range with 3.0%. The values of the percentages were similar in the regions of California and Texas with the only difference being observed in no admission of RBST with 9.3% for California and 5.3% in Texas. RBST is a synthetic growth hormone which is administered in cattle for increased milk production. In general, the participants' responses are expected with the attributes of produced without growth hormones and no-antibiotics that are included in organic attribute, rank higher supporting the argument of consumers' confusion regarding production attributes.

CHAPTER 5. RESULTS AND DISCUSSION

5.1 RPL Model and Preference Shares

A Chow test was conducted to determine if there are differences in the data of the two regions with the test results rejecting the null hypothesis of equality between the coefficient estimates of the two regions. Table 6 reports the RPL estimates for all three models. For the pooled sample all production attributes are statistically different ($p<0.05$) compared to the free-range attribute. All production attributes except for grass-fed and non-GMO are statistically different ($p<0.01$) than the free-range attribute in the California sample. For the Texas sample, all milk production attributes are statistically different ($p<0.01$) from the free-range production attribute. Standard deviations are also significant ($p<0.01$) for all attributes, suggesting heterogeneity.

Because the interpretation of the coefficient estimates is considered complicated, preference shares are calculated to measure the magnitude of each milk production attribute. The preference shares for all milk production attributes are reported in Figure 2. In general, the preference shares of produced without growth hormones and humanely raised animals are the most important preference shares across all samples capturing on average 44.7% of the preference shares. California ranks produced without growth hormones above humanely raised, but the opposite is observed in Texas. The least preferred preference share for all regions is that of organic production capturing on average 2.5% of the preference shares which is more than four times lower than the second-to-last preference share.

For all the other preference shares, differences in ranking are observed depending on the participants’ area of residence. The production attribute with the highest difference between California and Texas is that of non-GMO, 4.6% higher in Texas. As a result, California ranks non-GMO as their fifth preference, while Texas has ranked this production attribute as their third highest preference. The second largest difference is for the no-antibiotics attribute where California has ranked it the third most important preference share while Texas has it ranked as the fifth highest.

Summarizing the results of the coefficient estimates and the magnitude of the preference shares, two are considered the most significant. The first is regarding the preference share of organic attribute that is ranked as the least preferred milk production attribute across all samples. This is a paradox because, as mentioned in the introduction section, the certification of organic attribute includes the production practices of the other examining attributes. The above result strengthens the argument of consumers’ confusion regarding the organic attribute (Gifford and Bernard 2011) and even skepticism towards organic products (Yiridoe, Bonti-Ankomah and Martin 2005) which also agrees with the high percentage of negative opinion (49.7%) towards organic products in the current study.

The second significant result has to do with the heterogeneity of preferences in the sample. Aside from the statistical significance of standard deviations which strongly imply heterogeneity within the pooled, California and Texas sample, the differences in the ranking of the preference shares between the regions are also an indicator of heterogeneity. In the next part of the analysis, heterogeneity in preferences resulting from the participants' demographic background is examined with the use of OLS regressions.

5.2 OLS Regressions and Heterogeneity

Tables 7, 8, and 9 report the coefficient estimates for the seven preference shares from the OLS regressions for the pooled sample, California and Texas, respectively. Because the conducted Chow test showed differences in the data of California and Texas, the results of the pooled sample will not be summarized in this section. The most significant results of the OLS regressions conducted for the California and Texas participants in order to examine sources of heterogeneity within the two regions are discussed below.

Females in California had a lower preference share for the grass-fed ($p<0.01$), and the free-range ($p<0.01$) attributes than males, but a higher preference share for the non-GMO ($p<0.01$) attribute. There was no influence of gender in Texas. Texas respondents aged 54 or younger are less likely to prefer ($p<0.05$) the no-antibiotics attribute and are more likely to prefer the humanely raised attribute ($p<0.05$) compared to Texas residents aged 65 years or older. Age was not a statistically different in California. On the contrary, participants of white race tend to place more importance in the humanely raised attribute compared to participants of other races for both California ($p<0.05$) and Texas ($p<0.05$). Participants that have attended some high school or are high school graduates are less likely to prefer the no-antibiotics attribute than participants of advanced degree in California ($p<0.05$) but not in Texas. Participants that have attended some college or a trade vocational school are more likely to prefer the free-range attribute than participants of advanced degree in Texas ($p<0.01$) but not in California. College graduates tend to show a higher preference share for the produced without growth hormones attribute ($p<0.05$) and a lower preference share for the free-range attribute ($p<0.05$) compared to participants of advanced degree in Texas.

Participants of annual income less than $25,000 are more likely to prefer more the free-range production attribute than participants with annual income of $100,000 or greater in Texas ($p<0.01$). Participants of annual income from $25,000 to $49,999 tend to have a lower preference share for the organic attribute than participants with annual income of $100,000 or higher only in California ($p<0.05$) and a higher preference share for the grass-fed ($p<0.05$) and free-range ($p<0.01$) attributes than participants with annual income of $100,000 or greater in Texas. In addition to this, participants with annual income from $50,000 to $69,999 are less likely to prefer the organic attribute than participants with annual income of $100,000 or greater in California ($p<0.05$) but not in Texas. Californians with annual income from $70,000 to $99,999 tend to place less importance on the organic attribute ($p<0.05$) and more importance on the humanely raised ($p<0.01$) than Californians with income of $100,000 or higher but there is no statistically significant impact of the variable for Texans.

Participants that live in one-member households are more likely to prefer the humanely raised attribute than participants that live in households with three or more members in California ($p<0.01$) and in Texas ($p<0.01$) but only in Texas they tend to prefer less the non-GMO production attribute than participants that live in households with three or more members ($p<0.05$). Texas residents that are members in households of two members tend to place less importance ($p<0.05$) on the no-antibiotics production attribute than Texans that are members in households with three or more members but tend to place more importance on the free-range attribute ($p<0.05$) than Texans that are members in households with three or more members. Participants from Texas with a farm background are less likely to prefer the humanely raised attribute than participants that do not have a farm background ($p<0.05$). Participants that purchase their food in grocery stores tend to prefer the humanely raised ($p<0.01$) and grass-fed ($p<0.05$) attributes more than participants that purchase their food in other places (targeted/specialty retailers, general/dollar stores, convenience stores, farmer markets and others) in California. Texans that purchase food in grocery stores tend to prefer the non-GMO ($p<0.05$) attribute more than Texans that purchase their food in other places. On the other hand, participants that purchase food in grocery stores tend to prefer less the no-antibiotics ($p<0.01$) and the produced without growth hormones ($p<0.05$) attributes than participants that purchase food in other places in both regions.

Participants purchasing the store brand tend to prefer more the no-antibiotics attribute than participants purchasing other milk brands in California ($p<0.01$) and tend to prefer more the humanely raised attribute than participants purchasing other milk brands in Texas ($p<0.05$). In contrast, Californians purchasing the store brand show a lower preference share for the grass-fed ($p<0.05$) and the free-range ($p<0.05$) attributes than participants purchasing other milk brands. Finally, as the average percentage of organic purchased milk increases, participants are more likely to prefer the organic attribute in both California ($p<0.01$) and Texas ($p<0.01$). In California an increase in the average percentage of organic purchased milk leads to a decrease in the preference share of the free-range attribute ($p<0.05$) and in Texas an increase in the average percentage of organic purchased milk leads to a decrease in the preference share of humanely raised

($p<0.05$). The results for the humanely raised and free-range attributes can be interpreted as contradictive based on the thought that organic milk includes animal welfare and free-range standards on its production adding more to the argument of consumers' confusion regarding organic production attribute.

The analysis has shown heterogeneity in preference shares and the sources of heterogeneity differ between California and Texas for all production attributes. The results verify the hypothesis for heterogeneity in consumer preferences coming from demographics found in previous studies (Ellison, Brooks and Mieno 2017 and Cummins et al. 2016). Moreover, the heterogeneity of preferences is region specific as found when analyzing the California and Texas regions separately. An individual characteristic may be significant for a production attribute in one region but not significant in the other region and they vary across the production attributes. Farm background in this study is significant only in California for the organic attribute and is significant only in Texas for the humanely raised attribute. Further studies could be conducted to identify the causes behind the heterogeneity differences between California and Texas.

CHAPTER 6. CONCLUSIONS

The complexity of consumer preferences has increased as non-traditional production attributes like animal welfare and no-antibiotics have surfaced at the top of consumer preferences. The consumers' confusion regarding what production practices do the available production attributes encompass makes the situation more perplexing. The most characteristic example is the organic attribute which includes several of the non-traditional attributes but is not high in consumer preferences became the motivation of this research. The relative importance of seven credence production attributes is examined to identify consumer preferences. The elicitation method was PCM with the sample originating in the regions of California and Texas.

The analysis of the data showed that produced without growth hormones and cows humanely raised are the most important production attributes in both regions followed by no-antibiotics, grass-fed, non-GMO, free-range and organic. There are differences in the preference shares of the attributes between the two regions with the highest being 4.6% for no-antibiotics. The organic attribute was the least preferred production attribute; several times smaller than the second-to-last preference share although it includes all the other examined production attributes. This result supports the argument of consumers' confusion about the production attributes and the skepticism towards organic products, but another possible reason should be mentioned. Stolz et al. (2011) conducted choice experiments comparing organic and conventional products in Germany and Switzerland. Their results showed that consumers who occasionally buy organic products may turn to conventional products with some added specific attributes like non-GMO if the price of the product is low enough. Examining the above for the available attributes in the US market could be a topic of future research.

Heterogeneity in preferences was present and associated with demographic characteristics and buying habits. Analyzing the two regions separately, differences between California and Texas samples are observed regarding which characteristics are impactful on each one suggesting heterogeneity of consumers within the region and more importantly region-specific heterogeneity.

Based on the above, marketing strategies of producers, processors and retailers must be focused on the most preferred attributes of their clientele. Despite that, the food market actors need to pay attention to consumers' characteristics for early and effective changes in their production practices in order to increase their profits in the food sector.

One limitation to this research is that the sample is not representative of the general population on national and state level. For example, there is over-representation of people aged 55 years or older and under-representation of people of high-school or lower education. Because the sources of heterogeneity in consumer preferences examined are mainly the sociodemographic background of the participants and the participants are not representative of the US population, which might place a limitation on the generalizability of the results. Secondly, adding other possible sources of heterogeneity like personality traits or ethical beliefs might improve the explanatory power of the model on preferences which is low with just the inclusion of demographic characteristics and buying habits.

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APPENDIX FOR FIGURES

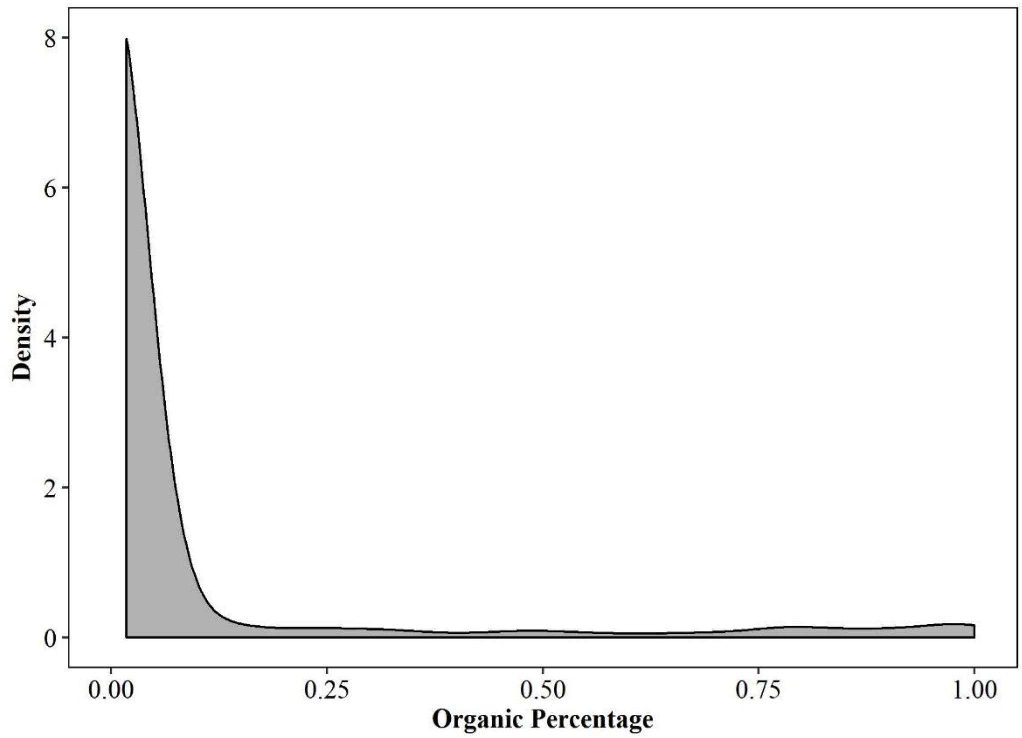

Figure 1. Density plot of survey participants' annual average percentage of organic purchased milk

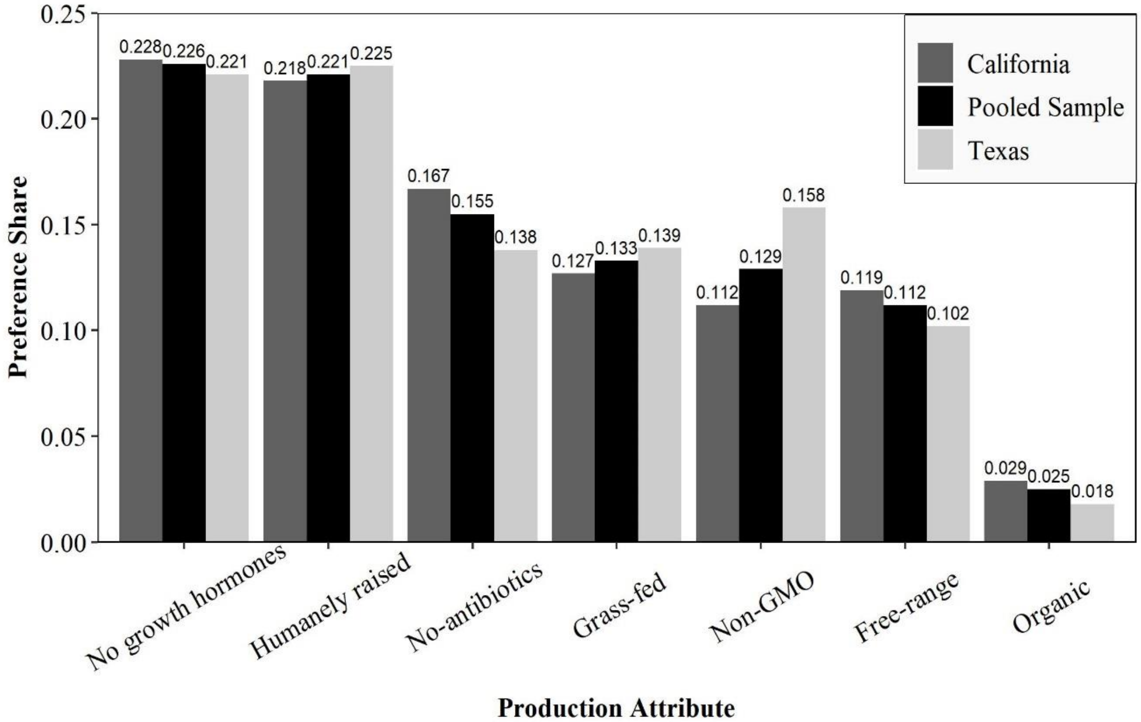

Figure 2. Preference shares of the milk production attributes grouped by sample

APPENDIX FOR TABLES

Table 1. Milk production attributes

Attributes	Variable	Description
Organic	org	Milk is certified organic
No-antibiotics	no_ant	Cows are not administered antibiotics
Produced without growth hormones	no_grho	Cows are not administered growth hormones
Humanely raised	hum_ra	Cows are humanely raised
Grass-fed	gr_fed	Cows are grass-fed
Non-GMO	no_gmo	Genetically modified organisms were not used in the production of milk
Free-range	free_ra	Cows are raised in a free-range environment

Table 2. Participant characteristics used in OLS analysis

Characteristic	Variable	Definition
Female	female	1 if female; 0 otherwise
Age	age1	1 if age is 54 years or less; 0 otherwise
	age2	1 if age is 55-64 years; 0 otherwise
	age3	1 if age is 65 years or more; 0 otherwise
Race	white	1 if race is white; 0 otherwise
Education	edu1	1 if education completed is some or high-school; 0 otherwise
	edu2	1 if education completed is some college or trade vocational school; 0 otherwise
	edu3	1 if education completed is college (B.A. or B.S.); 0 otherwise
	edu4	1 if education completed is of advanced degree; 0 otherwise
Annual income per household	inc1	1 if income is less than $25,000; 0 otherwise
	inc2	1 if income is $25,000-$49,999; 0 otherwise
	inc3	1 if income is $50,000-$69,999; 0 otherwise
	inc4	1 if income is $70,000-$99,999; 0 otherwise
	inc5	1 if income is $100,000 or more; 0 otherwise
Household size	hh_size1	1 if household has 1 member; 0 otherwise
	hh_size2	1 if household has 2 members; 0 otherwise
	hh_size3	1 if household has 3 members or more; 0 otherwise
Farm background	frm_bg	1 if participant has farm background; 0 otherwise
Primary shopper	pr_shopper	1 if participant is the primary shopper; 0 otherwise
Region of residence*	TX	1 if region of residence is Texas; 0 otherwise
Frequency of purchasing milk	m_freq1	1 if frequency is a few times per year; 0 otherwise
	m_freq2	1 if frequency is once a month; 0 otherwise
	m_freq3	1 if frequency is once a week or more; 0 otherwise
Place of purchasing food	pur_pl	1 if place is grocery store; 0 otherwise
Frequency of purchasing food to be prepared and eaten at home by the family	ck_freq1	1 if frequency is once a week or more; 0 otherwise
	ck_freq2	1 if frequency is 2-3 times a month; 0 otherwise
	ck_freq3	1 if frequency is less than twice a month; 0 otherwise

*The region of residence characteristic is excluded from the model when the analysis for California and Texas sample is conducted.

Table 2. Participant characteristics used in OLS analysis continued

Characteristic	Variable	Definition
Weekly expense on food during grocery shopping	exp1	1 if expense is $39 or less; 0 otherwise
	exp2	1 if expense is $40-$59; 0 otherwise
	exp3	1 if expense is $60-$79; 0 otherwise
	exp4	1 if expense is $80-$99; 0 otherwise
	exp5	1 if expense is $100-$119; 0 otherwise
	exp6	1 if expense is $120-$139; 0 otherwise
	exp7	1 if expense is $140 or more; 0 otherwise
Brand of purchasing milk	st_brand	1 if brand is store brand; 0 otherwise
Fat content of purchasing milk	fat1	1 if milk is whole-fat; 0 otherwise
	fat2	1 if milk has 2.0% fat content; 0 otherwise
	fat3	1 if milk has 1.0% fat content; 0 otherwise
	fat4	1 if milk is skim; 0 otherwise
Size of milk container	m_cont1	1 if size is gallon; 0 otherwise
	m_cont2	1 if size is half-gallon; 0 otherwise
	m_cont3	1 if size is smaller than half-gallon; 0 otherwise
Skeptical towards products labeled organic	op_org1	1 if disagrees; 0 otherwise
	op_org2	2 if neutral; 0 otherwise
	op_org3	3 if agrees; 0 otherwise
Average percentage of organic purchased milk	org_per	The ratio of annual organic milk volume purchased to the total annual milk volume purchased

Table 3. Demographic characteristics of survey respondents compared to census data

Characteristic	Pooled Sample (%)	California Sample (%)	Texas Sample (%)	US Census (%)	California Census (%)	Texas Census (%)
Gender						
Female	68.3	63.8	73.6	50.8	50.3	50.3
Age						
Less than 54 years old	22.9	24.2	21.3	72.4	75.0	77.2
Between 55-64 years old	33.2	32.9	33.6	12.7	11.8	11.1
Over 64 years old	43.9	42.9	45.1	14.9	13.2	11.7
Race						
White	77.7	74.6	81.3	75.7	64.5	76.8
Other	22.3	25.4	18.7	24.3	35.5	23.2
Education						
Some high school or high school graduate	12.0	9.8	14.6	40.5	38.6	43.0
Some college or trade vocational school	38.8	39.1	38.5	31.2	31.8	31.1
College graduate (B.A. or B.S.) *	32.3	34.4	30.0	18.0	19.0	17.4
Advanced degree	16.9	16.8	16.9	10.3	10.6	8.5

* Because of the US census data structure there is only a percentage including residents below 25 years old with college or graduate degree. The percentage of residents below 25 having a graduate degree is considered low and is added to percentage with college degree.

Table 3. Demographic characteristics of survey respondents compared to census data continued

Characteristic	Pooled Sample (%)	California Sample (%)	Texas Sample (%)	US Census (%)	California Census (%)	Texas Census (%)
Annual income per household						
Under $25,000 per year	11.5	11.7	11.4	20.2		
Between $25,000 to $49,999	24.0	22.0	26.3	21.6		
Between $50,000 to $69,999	17.9	16.6	19.5	13.5		
Between $70,000 to $99,999	23.7	23.2	24.2	15.5		
Over $100,000	22.9	26.5	18.6	29.3		
Household size						
1 individual in the household	27.4	29.4	25.1			
2 individuals in the household	48.9	46.8	51.3			
3 or more individuals in the household	23.7	23.8	23.6			
Farm background						
Yes	10.2	9.4	11.1			
Primary shopper						
Yes	93.5	93.2	93.8			
Region of residence						
California	53.9					
Texas	46.1					
N^{o} of observations	1881	1013	868			

Table 4. Buying habits of survey respondents

Characteristic	Pooled Sample (%)	California Sample (%)	Texas Sample (%)
Frequency of purchasing milk			
A few times a year	14.1	15.7	12.3
About once a month	33.8	35.3	31.9
Once a week or more	52.1	49.0	55.8
Place of purchasing food			
Grocery store/Supermarket	93.8	91.2	96.8
Other	6.2	8.8	3.2
Frequency of purchasing food to be prepared and eaten at home by the family			
Once a week or more	65.1	66.0	64.1
2-3 times a month	25.8	24.0	28.0
Less than twice a month	9.0	10.0	7.9
Weekly expense on food during grocery shopping			
$39 or less	13.5	14.2	12.6
$40-$59	19.2	19.2	19.2
$60-$79	19.3	18.6	20.2
$80-$99	14.2	15.0	13.2
$100- $119	15.7	14.7	16.9
$120-$139	8.4	8.4	8.4
$140 or more	9.7	9.9	9.5
Brand of purchasing milk			
Store Brand	70.1	63.6	77.7
Other	29.9	36.4	22.3
Fat content of purchasing milk			
Whole	26.3	24.6	28.3
2.0%	40.0	39.7	40.3
1.0%	16.1	19.3	12.3
Skim	17.6	16.4	19.0
Size of milk container			
Gallon	47.3	41.5	54.2
Half Gallon	35.4	38.4	31.9
Smaller than half gallon	17.3	20.1	13.9
Skeptical towards products labeled organic			
Disagree	20.9	22.8	18.7
Neutral	29.0	28.2	29.9
Agree	50.1	49.0	51.4
Average percentage of organic purchased milk	6.2	6.6	5.8
N^{o} of observations	1881	1013	868

Table 5. Shares of additional production attributes selected by survey respondents

Milk Purchase Attributes	Pooled Sample (%)	California Sample (%)	Texas Sample (%)
Organic	11.0	11.3	10.6
No Recombinant Bovine Somatotropin (RBST) (growth hormone)	7.4	9.3	5.3
No Genetically Modified Organisms (GMO)	10.9	11.3	10.4
Free-range	3.0	2.9	3.2
Humanely raised	4.8	4.7	4.8
No antibiotics	13.7	14.4	12.8
No growth hormones	15.4	15.7	15.0
Grass-fed	5.2	4.3	6.2
Other	6.5	6.9	6.1
Conventional	66.1	65.4	66.9
N° of observations	1881	1013	868

Table 6. RPL estimates for production attributes by state and pooled

Production Attribute	Pooled Estimates (Standard Error)	Pooled Standard Deviation (Standard Error)	California Estimates (Standard Error)	California Standard Deviation (Standard Error)	Texas Estimates (Standard Error)	Texas Standard Deviation (Standard Error)
Organic	-1.514*** (0.132)	1.690*** (0.160)	-1.422*** (0.165)	1.652*** (0.205)	-1.716*** (0.238)	1.818*** (0.280)
No-antibiotics	0.318*** (0.054)	1.054*** (0.117)	0.339*** (0.076)	1.113*** (0.160)	0304*** (0.081)	1.031*** (0.280)
Produced without growth hormones	0.696*** (0.065)	1.012*** (0.110)	0.649*** (0.084)	0.920*** (0.145)	0.775*** (0.105)	1.110*** (0.166)
Humanely raised	0.674*** (0.068)	1.225*** (0.114)	0.603*** (0.086)	1.149*** (0.145)	0.793*** (0.115)	1.382*** (0.193)
Grass-fed	0.168*** (0.055)	1.147*** (0.111)	0.0605 (0.070)	1.057*** (0.138)	0.316*** (0.090)	1.282*** (0.184)
Non-GMO	0.137** (0.062)	1.504*** (0.131)	-0.0644 (0.081)	1.437*** (0.174)	0.438*** (0.105)	1.628*** (0.221)
Free-range	0.000		0.000		0.000	
Nº of individuals	1881		1013		868	
Nº of choices	18810		10130		8680	
Log likelihood	-5539.3		-3000.1		-2524.0	

***Denotes statistical significance of the mean value at p<0.01
**Denotes statistical significance of the mean value at p<0.05

Table 7. Regression estimates for preference shares for pooled sample

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Intercept	0.062*** (0.014)	0.195*** (0.016)	0.231*** (0.019)	0.133*** (0.024)	0.141*** (0.016)	0.135*** (0.023)	0.103*** (0.004)
Gender vs male							
female	-0.004 (0.003)	-0.002 (0.004)	0.003 (0.005)	0.003 (0.006)	-0.016*** (0.005)	0.019*** (0.006)	-0.003*** (0.001)
Age of the participant vs age3							
age1	0.004 (0.004)	-0.005 (0.005)	-0.001 (0.006)	0.021** (0.008)	-0.011* (0.006)	-0.006 (0.008)	-0.002** (0.001)
age2	0.002 (0.003)	0.002 (0.004)	0.004 (0.005)	0.003 (0.006)	-0.004 (0.005)	-0.005 (0.006)	-0.001 (0.001)
Race of the participant vs other							
white	-0.007* (0.004)	-0.004 (0.005)	-0.004 (0.005)	0.024*** (0.007)	-0.005 (0.005)	-0.003 (0.007)	-0.001 (0.001)
Education vs edu4							
edu1	-0.007 (0.005)	-0.020*** (0.007)	0.021** (0.009)	0.001 (0.011)	-0.005 (0.008)	0.010 (0.011)	0.000 (0.002)
edu2	-0.003 (0.004)	-0.014** (0.006)	0.007 (0.007)	0.010 (0.008)	-0.007 (0.006)	0.008 (0.008)	-0.001 (0.001)
edu3	0.000 (0.004)	-0.012** (0.006)	0.017*** (0.007)	-0.007 (0.008)	-0.002 (0.006)	0.004 (0.008)	-0.001 (0.001)

Table 7. Regression estimates for preference shares for pooled sample continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Annual income per household vs inc5							
inc1	-0.001 (0.006)	-0.005 (0.007)	-0.002 (0.009)	-0.002 (0.012)	0.008 (0.008)	0.002 (0.011)	0.002 (0.001)
inc2	-0.006 (0.005)	-0.007 (0.006)	-0.012* (0.007)	0.001 (0.009)	0.014** (0.007)	0.007 (0.009)	0.003** (0.001)
inc3	-0.005 (0.005)	-0.008 (0.006)	-0.007 (0.007)	0.007 (0.009)	0.008 (0.007)	0.004 (0.009)	0.000 (0.001)
inc4	-0.008* (0.005)	-0.005 (0.006)	-0.001 (0.007)	0.016* (0.009)	0.003 (0.006)	-0.005 (0.008)	0.000 (0.001)
Household size vs hh_size3							
hh_size1	0.000 (0.005)	-0.003 (0.006)	-0.006 (0.008)	0.042*** (0.010)	-0.009 (0.007)	-0.026*** (0.009)	0.001 (0.001)
hh_size2	0.001 (0.004)	-0.004 (0.005)	-0.002 (0.006)	0.013* (0.008)	0.000 (0.006)	-0.009 (0.008)	0.000 (0.001)
Farm background vs No							
frm_bg	-0.007** (0.003)	-0.001 (0.006)	0.001 (0.007)	-0.008 (0.009)	0.008 (0.007)	0.005 (0.010)	0.002 (0.001)
Primary shopper vs No							
pr_shopper	-0.007 (0.006)	-0.002 (0.008)	0.011 (0.009)	-0.005 (0.011)	-0.011 (0.009)	0.015 (0.011)	-0.002 (0.001)

Table 7. Regression estimates for preference shares for pooled sample continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Region of residence vs CA							
TX	-0.002 (0.003)	-0.006 (0.004)	-0.004 (0.005)	-0.007 (0.006)	0.003 (0.004)	0.017*** (0.006)	-0.002*** (0.001)
Frequency of purchasing milk vs m_freq3							
m_freq1	0.006 (0.005)	0.002 (0.006)	-0.009 (0.007)	-0.002 (0.009)	-0.007 (0.006)	0.012 (0.009)	-0.001 (0.001)
m_freq2	0.001 (0.003)	0.006 (0.004)	-0.002 (0.005)	0.003 (0.007)	-0.004 (0.005)	-0.005 (0.006)	0.001 (0.001)
Place of purchasing food vs Other							
pur_pl	-0.004 (0.008)	-0.027*** (0.008)	-0.020** (0.009)	0.029*** (0.011)	0.016** (0.007)	0.007 (0.011)	0.000 (0.002)
Frequency of purchasing food to be prepared and eaten at home by the family vs ck_freq 4							
ck_freq1	0.001 (0.005)	0.009 (0.006)	0.004 (0.008)	-0.013 (0.011)	0.007 (0.007)	-0.008 (0.010)	0.000 (0.002)
ck_freq2	-0.002 (0.005)	0.003 (0.007)	0.001 (0.008)	-0.016 (0.011)	0.015** (0.008)	-0.002 (0.011)	0.000 (0.002)

Table 7. Regression estimates for preference shares for pooled sample continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Weekly expense on food during groceryshopping vs exp7							
exp1	0.000 (0.007)	0.015* (0.008)	0.004 (0.010)	-0.011 (0.012)	0.000 (0.009)	-0.006 (0.012)	-0.002 (0.002)
exp2	-0.002 (0.006)	0.012 (0.007)	0.000 (0.009)	-0.003 (0.011)	-0.009 (0.009)	0.003 (0.012)	-0.002 (0.002)
exp3	-0.007 (0.006)	0.003 (0.007)	-0.006 (0.009)	0.017 (0.011)	-0.001 (0.009)	-0.004 (0.011)	-0.003* (0.002)
exp4	-0.002 (0.006)	0.003 (0.007)	0.007 (0.010)	0.000 (0.012)	0.000 (0.009)	-0.009 (0.012)	0.001 (0.002)
exp5	-0.002 (0.006)	0.005 (0.007)	0.001 (0.009)	0.019 (0.012)	-0.013 (0.008)	-0.008 (0.011)	-0.001 (0.002)
exp6	-0.006 (0.006)	0.007 (0.009)	-0.010 (0.011)	0.018 (0.013)	0.003 (0.010)	-0.011 (0.013)	-0.001 (0.002)
Brand of purchasing milk vs other							
st_brand	-0.003 (0.003)	0.006 (0.004)	0.000 (0.005)	0.010 (0.006)	-0.007 (0.005)	-0.005 (0.006)	-0.001 (0.001)

Table 7. Regression estimates for preference shares for pooled sample continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Fat content of purchasing milk vs fat4							
fat1	-0.005 (0.005)	-0.012** (0.006)	-0.009 (0.007)	-0.001 (0.009)	0.012* (0.006)	0.014* (0.009)	0.000 (0.001)
fat2	-0.006 (0.004)	-0.012** (0.005)	-0.008 (0.006)	0.010 (0.008)	0.006 (0.006)	0.012 (0.008)	-0.001 (0.001)
fat3	-0.006 (0.005)	-0.004 (0.006)	-0.001 (0.008)	0.006 (0.010)	0.003 (0.007)	0.003 (0.009)	-0.001 (0.001)
Size of milk container vs m_cont3							
m_cont1	0.000 (0.004)	-0.007 (0.006)	-0.008 (0.007)	0.022** (0.009)	0.008 (0.006)	-0.014* (0.009)	0.000 (0.001)
m_cont2	0.006 (0.004)	-0.008 (0.006)	-0.011* (0.006)	0.022** (0.009)	-0.002 (0.006)	-0.007 (0.009)	-0.001 (0.001)
Opinion towards organic product vs op_org3							
op_org1	0.014*** (0.004)	0.004 (0.005)	-0.009 (0.006)	-0.004 (0.008)	-0.005 (0.005)	-0.001 (0.007)	0.000 (0.001)
op_org2	0.003 (0.003)	0.010** (0.004)	-0.002 (0.005)	-0.007 (0.007)	0.004 (0.005)	-0.007 (0.006)	0.000 (0.001)

Table 7. Regression estimates for preference shares for pooled sample continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Average percentage of organic purchased milk							
org_per	0.057*** (0.011)	-0.012 (0.009)	0.003 (0.011)	-0.030** (0.014)	-0.010 (0.010)	-0.005 (0.015)	-0.003* (0.002)
R^2	0.088	0.037	0.021	0.048	0.038	0.030	0.027
Nº of individuals	1881	1881	1881	1881	1881	1881	1881

***Denotes statistical significance of the mean value at p<0.01
**Denotes statistical significance of the mean value at p<0.05
*Denotes statistical significance of the mean value at p<0.10

Table 8. Regression estimates for preference shares for California residents

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Intercept	0.076*** (0.019)	0.215*** (0.023)	0.209*** (0.022)	0.119*** (0.028)	0.149*** (0.019)	0.119*** (0.026)	0.112*** (0.005)
Gender vs male							
female	-0.007 (0.004)	0.002 (0.006)	-0.002 (0.006)	0.007 (0.008)	-0.018*** (0.005)	0.022*** (0.007)	-0.004*** (0.001)
Age of the participant vs age3							
age1	-0.002 (0.006)	0.004 (0.007)	0.004 (0.007)	0.013 (0.010)	-0.010 (0.007)	-0.007 (0.009)	-0.002* (0.001)
age2	-0.001 (0.005)	0.006 (0.007)	0.009 (0.006)	-0.001 (0.008)	-0.006 (0.005)	-0.006 (0.008)	-0.001 (0.001)
Race vs other							
white	-0.007 (0.005)	0.000 (0.007)	-0.004 (0.006)	0.018** (0.009)	-0.001 (0.006)	-0.004 (0.008)	-0.002 (0.001)
Education vs edu4							
edu1	-0.007 (0.008)	-0.029** (0.011)	0.019* (0.011)	0.002 (0.015)	0.000 (0.011)	0.012 (0.014)	0.003 (0.002)
edu2	-0.001 (0.006)	-0.015* (0.009)	0.014* (0.008)	0.007 (0.011)	-0.011 (0.007)	0.004 (0.010)	0.002 (0.002)
edu3	0.006 (0.006)	-0.011 (0.008)	0.013* (0.008)	-0.008 (0.010)	-0.005 (0.007)	0.004 (0.010)	0.001 (0.002)

Table 8. Regression estimates for preference shares for California residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Annual income per household vs inc5							
inc1	-0.007 (0.008)	-0.007 (0.011)	0.000 (0.010)	0.001 (0.014)	0.002 (0.009)	0.014 (0.014)	-0.002 (0.002)
inc2	-0.014** (0.006)	-0.009 (0.009)	-0.005 (0.008)	0.008 (0.012)	0.007 (0.008)	0.013 (0.011)	0.000 (0.002)
inc3	-0.014** (0.007)	-0.006 (0.009)	0.002 (0.009)	0.007 (0.011)	0.003 (0.008)	0.008 (0.011)	-0.001 (0.002)
inc4	-0.013** (0.006)	-0.010 (0.008)	-0.009 (0.008)	0.029*** (0.010)	0.004 (0.007)	0.001 (0.009)	-0.001 (0.001)
Household size vs hh_size3							
hh_size1	-0.005 (0.007)	0.005 (0.009)	-0.007 (0.009)	0.038*** (0.012)	-0.013 (0.008)	-0.020* (0.011)	0.000 (0.002)
hh_size2	-0.003 (0.006)	0.002 (0.007)	-0.004 (0.008)	0.012 (0.010)	-0.003 (0.007)	-0.001 (0.009)	-0.002 (0.002)
Farm background vs No							
frm_bg	-0.009* (0.005)	-0.005 (0.009)	-0.009 (0.010)	0.012 (0.013)	0.001 (0.008)	0.008 (0.012)	0.002 (0.002)
Primary shopper vs No							
pr_shopper	-0.009 (0.009)	-0.014 (0.012)	0.021** (0.010)	-0.001 (0.014)	-0.006 (0.011)	0.011 (0.013)	-0.001 (0.002)

Table 8. Regression estimates for preference shares for California residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Frequency of purchasing milk vs m_freq3							
m_freq1	0.008 (0.007)	0.014 (0.009)	-0.013* (0.008)	-0.006 (0.011)	-0.009 (0.007)	0.006 (0.010)	-0.001 (0.002)
m_freq2	0.004 (0.004)	0.007 (0.006)	-0.007 (0.006)	0.004 (0.008)	-0.005 (0.005)	-0.002 (0.007)	0.000 (0.001)
Place of purchasing food vs Other							
pur_pl	-0.007 (0.009)	-0.032*** (0.010)	-0.011 (0.010)	0.037*** (0.011)	0.016** (0.007)	-0.004 (0.011)	0.001 (0.002)
Frequency of purchasing food to be prepared and eaten at home by the familyvs ck_freq 4							
ck_freq1	-0.003 (0.008)	0.012 (0.008)	0.010 (0.009)	-0.008 (0.013)	0.004 (0.008)	-0.015 (0.013)	-0.001 (0.002)
ck_freq2	-0.003 (0.008)	-0.001 (0.009)	0.014 (0.010)	-0.011 (0.014)	0.014 (0.009)	-0.013 (0.013)	0.000 (0.002)

Table 8. Regression estimates for preference shares for California residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Weekly expense on food during grocery shopping vs exp7							
exp1	0.011 (0.010)	0.015 (0.012)	-0.008 (0.013)	-0.016 (0.015)	0.001 (0.011)	-0.001 (0.014)	-0.002 (0.002)
exp2	-0.003 (0.009)	0.008 (0.011)	0.004 (0.012)	-0.009 (0.014)	-0.006 (0.010)	0.008 (0.013)	-0.002 (0.002)
exp3	-0.007 (0.009)	0.005 (0.011)	-0.010 (0.012)	0.004 (0.014)	-0.003 (0.010)	0.013 (0.013)	-0.003 (0.002)
exp4	-0.003 (0.009)	0.003 (0.011)	0.006 (0.012)	-0.009 (0.015)	-0.006 (0.010)	0.009 (0.013)	0.000 (0.002)
exp5	-0.007 (0.009)	0.002 (0.011)	-0.003 (0.011)	0.016 (0.014)	-0.019** (0.009)	0.014 (0.013)	-0.003 (0.002)
exp6	-0.011 (0.010)	-0.005 (0.013)	-0.013 (0.013)	0.023 (0.016)	-0.002 (0.012)	0.010 (0.015)	-0.002 (0.003)
Brand of purchasing milk vs other							
st_brand	-0.003 (0.005)	0.018*** (0.006)	-0.006 (0.006)	0.002 (0.008)	-0.012** (0.005)	0.005 (0.007)	-0.003** (0.001)

Table 8. Regression estimates for preference shares for California residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Fat content of purchasing milk vs fat4							
fat1	-0.001 (0.007)	-0.025*** (0.009)	-0.003 (0.009)	0.004 (0.011)	0.010 (0.007)	0.016 (0.011)	-0.001 (0.002)
fat2	-0.004 (0.006)	-0.018** (0.008)	-0.007 (0.008)	0.007 (0.010)	0.011 (0.007)	0.010 (0.009)	0.001 (0.002)
fat3	-0.003 (0.007)	-0.016* (0.009)	0.007 (0.009)	0.003 (0.012)	0.010 (0.008)	-0.002 (0.010)	0.000 (0.002)
Size of milk container vs m_cont3							
m_cont1	0.000 (0.006)	-0.013 (0.009)	-0.006 (0.008)	0.028** (0.011)	0.004 (0.007)	-0.011 (0.010)	-0.001 (0.002)
m_cont2	0.009 (0.006)	-0.011 (0.008)	-0.004 (0.007)	0.023** (0.011)	-0.005 (0.006)	-0.012 (0.010)	0.000 (0.002)
Opinion towards organic product vs op_org3							
op_org1	0.017*** (0.006)	0.009 (0.007)	-0.014** (0.007)	0.002 (0.009)	-0.009 (0.006)	-0.005 (0.008)	-0.001 (0.001)
op_org2	0.003 (0.004)	0.010 (0.007)	-0.002 (0.006)	0.003 (0.008)	-0.006 (0.006)	-0.007 (0.008)	-0.001 (0.001)

Table 8. Regression estimates for preference shares for California residents continued

Variable	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
	Dependent variable: preference share for						
Average percentage of organic purchased milk							
org_per	0.063*** (0.016)	-0.008 (0.013)	-0.005 (0.013)	-0.030* (0.018)	-0.020* (0.011)	0.005 (0.017)	-0.006** (0.003)
R^2	0.110	0.067	0.034	0.062	0.058	0.035	0.044
Nº of individuals	1013	1013	1013	1013	1013	1013	1013

***Denotes statistical significance of the mean value at p<0.01
**Denotes statistical significance of the mean value at p<0.05
* Denotes statistical significance of the mean value at p<0.10

Table 9. Regression estimates for preference shares for Texas residents

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Intercept	0.033*	0.163***	0.259***	0.173***	0.136***	0.153***	0.082***
	(0.017)	(0.025)	(0.031)	(0.045)	(0.032)	(0.044)	(0.005)
Gender vs male							
female	0.001	-0.007	0.009	-0.004	-0.009	0.012	-0.001
	(0.005)	(0.006)	(0.008)	(0.011)	(0.008)	(0.012)	(0.001)
Age of the participant vs age3							
age1	0.011*	-0.015**	-0.011	0.032**	-0.008	-0.006	-0.002
	(0.006)	(0.007)	(0.010)	(0.014)	(0.010)	(0.015)	(0.002)
age2	0.003	-0.003	-0.004	0.011	-0.004	-0.002	-0.002
	(0.004)	(0.006)	(0.008)	(0.011)	(0.008)	(0.011)	(0.001)
Race vs other							
white	-0.006	-0.005	-0.006	0.032**	-0.012	-0.003	0.001
	(0.006)	(0.006)	(0.009)	(0.013)	(0.009)	(0.014)	(0.001)
Education vs edu4							
edu1	-0.008	-0.014	0.024*	0.002	-0.011	0.010	-0.003
	(0.007)	(0.010)	(0.014)	(0.017)	(0.013)	(0.018)	(0.002)
edu2	-0.004	-0.013*	-0.001	0.010	0.001	0.012	-0.004***
	(0.006)	(0.008)	(0.011)	(0.014)	(0.011)	(0.015)	(0.002)
edu3	-0.006	-0.013	0.023**	-0.007	0.002	0.005	-0.003**
	(0.006)	(0.008)	(0.011)	(0.014)	(0.011)	(0.014)	(0.002)

Table 9. Regression estimates for preference shares for Texas residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Annual income per household vs inc5							
inc1	0.007	-0.001	-0.008	-0.009	0.020	-0.016	0.007****
	(0.009)	(0.010)	(0.015)	(0.020)	(0.015)	(0.021)	(0.002)
inc2	0.002	-0.001	-0.018	-0.014	0.026**	-0.001	0.006***
	(0.006)	(0.008)	(0.013)	(0.016)	(0.012)	(0.017)	(0.002)
inc3	0.006	-0.009	-0.016	0.002	0.020	-0.005	0.003
	(0.007)	(0.008)	(0.012)	(0.016)	(0.012)	(0.017)	(0.002)
inc4	-0.001	0.000	0.010	-0.003	0.004	-0.012	0.002
	(0.006)	(0.008)	(0.011)	(0.015)	(0.010)	(0.016)	(0.002)
Household size vs hh_size3							
hh_size1	0.005	-0.012	-0.004	0.049***	0.001	-0.039**	0.001
	(0.007)	(0.009)	(0.012)	(0.017)	(0.012)	(0.017)	(0.002)
hh_size2	0.007	-0.014**	-0.002	0.018	0.007	-0.021	0.003**
	(0.005)	(0.007)	(0.010)	(0.013)	(0.011)	(0.014)	(0.002)
Farm background vs No							
frm_bg	-0.003	0.002	0.007	-0.032**	0.017	0.007	0.002
	(0.005)	(0.008)	(0.011)	(0.013)	(0.011)	(0.016)	(0.002)

Table 9. Regression estimates for preference shares for Texas residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Primary shopper vs No							
pr_shopper	-0.007 (0.007)	0.012 (0.011)	0.001 (0.015)	-0.011 (0.020)	-0.022 (0.015)	0.027 (0.021)	-0.002 (0.002)
Frequency of purchasing milk vs m_freq3							
m_freq1	0.005 (0.008)	-0.010 (0.009)	-0.006 (0.012)	-0.006 (0.017)	-0.008 (0.012)	0.027 (0.018)	-0.002 (0.002)
m_freq2	0.000 (0.004)	0.005 (0.006)	0.006 (0.008)	0.000 (0.011)	-0.004 (0.008)	-0.009 (0.012)	0.001 (0.001)
Place of purchasing food vs Other							
pur_pl	0.004 (0.012)	-0.015 (0.015)	-0.035** (0.018)	-0.015 (0.025)	0.005 (0.020)	0.057** (0.024)	0.000 (0.003)
Frequency of purchasing food to be prepared and eaten at home by the family vs ck_freq 4							
ck_freq1	0.005 (0.005)	0.000 (0.010)	-0.005 (0.014)	-0.020 (0.019)	0.015 (0.013)	0.002 (0.019)	0.002 (0.002)
ck_freq2	0.002 (0.006)	0.001 (0.011)	-0.020 (0.014)	-0.019 (0.019)	0.020 (0.014)	0.013 (0.019)	0.003 (0.002)

Table 9. Regression estimates for preference shares for Texas residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Weekly expense on food during grocery shopping vs exp7							
exp1	-0.010 (0.008)	0.017 (0.011)	0.015 (0.017)	0.002 (0.022)	-0.006 (0.017)	-0.014 (0.022)	-0.003 (0.003)
exp2	0.000 (0.007)	0.020** (0.010)	-0.011 (0.015)	0.012 (0.021)	-0.015 (0.016)	-0.004 (0.021)	-0.002 (0.002)
exp3	-0.006 (0.007)	0.005 (0.009)	0.000 (0.015)	0.042** (0.019)	-0.005 (0.015)	-0.034* (0.020)	-0.002 (0.002)
exp4	0.002 (0.008)	0.006 (0.010)	0.004 (0.016)	0.021 (0.021)	0.007 (0.017)	-0.041** (0.021)	0.001 (0.002)
exp5	0.004 (0.007)	0.011 (0.009)	0.005 (0.015)	0.031 (0.020)	-0.007 (0.015)	-0.043** (0.019)	0.001 (0.002)
exp6	-0.001 (0.008)	0.018* (0.011)	0.000 (0.017)	0.016 (0.022)	0.011 (0.018)	-0.045* (0.023)	0.001 (0.003)
Brand of purchasing milk vs other							
st_brand	-0.004 (0.006)	-0.009 (0.006)	0.011 (0.008)	0.026** (0.011)	0.001 (0.008)	-0.025* (0.013)	0.000 (0.001)

Table 9. Regression estimates for preference shares for Texas residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Fat content of purchasing milk vs fat4							
fat1	-0.007 (0.007)	-0.001 (0.008)	-0.016 (0.011)	-0.002 (0.014)	0.018* (0.011)	0.006 (0.015)	0.002 (0.002)
fat2	-0.007 (0.006)	-0.006 (0.007)	-0.008 (0.010)	0.016 (0.013)	-0.004 (0.010)	0.011 (0.014)	-0.002 (0.001)
fat3	-0.010 (0.007)	0.004 (0.009)	-0.015 (0.013)	0.016 (0.017)	-0.011 (0.013)	0.016 (0.019)	-0.002 (0.002)
Size of milk container vs m_cont3							
m_cont1	-0.001 (0.006)	0.001 (0.009)	-0.013 (0.012)	0.014 (0.016)	0.012 (0.011)	-0.012 (0.016)	0.000 (0.002)
m_cont2	0.002 (0.006)	-0.002 (0.009)	-0.025** (0.011)	0.021 (0.016)	-0.001 (0.012)	0.007 (0.016)	-0.002 (0.002)
Opinion towards organic product vs op_org3							
op_org1	0.013** (0.006)	-0.001 (0.007)	-0.002 (0.010)	-0.015 (0.014)	0.000 (0.009)	0.004 (0.014)	0.001 (0.002)
op_org2	0.004 (0.004)	0.010* (0.006)	-0.002 (0.008)	-0.023** (0.011)	0.017** (0.008)	-0.009 (0.011)	0.002 (0.001)

Table 9. Regression estimates for preference shares for Texas residents continued

Variable	Dependent variable: preference share for						
	Organic	No-antibiotics	Produced without growth hormones	Humanely raised	Grass-fed	Non-GMO	Free-range
Average percentage of organic purchased milk							
org_per	0.051*** (0.014)	-0.009 (0.012)	0.008 (0.021)	-0.050** (0.025)	0.005 (0.021)	-0.007 (0.031)	0.001 (0.003)
R^2	0.080	0.040	0.055	0.061	0.050	0.040	0.059
Nº of individuals	868	868	868	868	868	868	868

***Denotes statistical significance of the mean value at p<0.01
**Denotes statistical significance of the mean value at p<0.05
* Denotes statistical significance of the mean value at p<0.10